Tiny Crystals as Micro-Photoelectrochemical Cells

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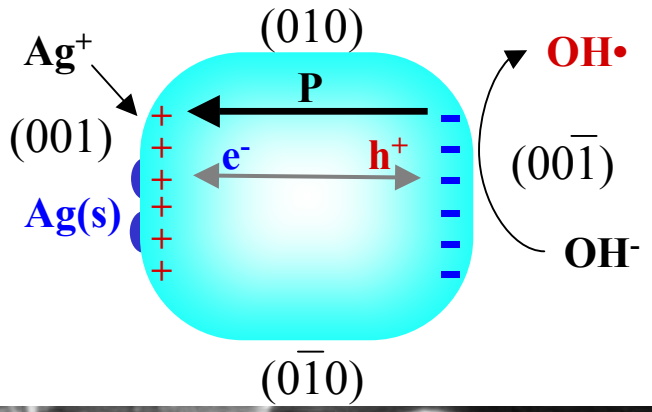
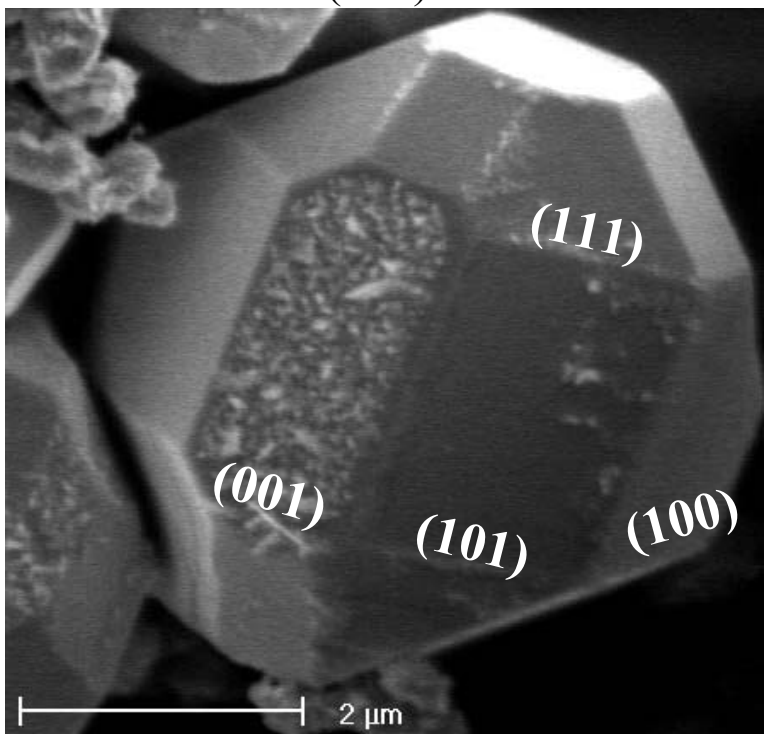
Photochemical reactions on ceramic surfaces are important for sustainable hydrogen fuel synthesis. Macroscopic photoelectrochemical cells (PECs) produce hydrogen efficiently because they separate charge carriers to prevent recombination. We have found that micron-scale ferroelectric crystals behave as miniature PECs. The internal dipolar field forces photogenerated carriers in opposite directions, so that reaction products form on opposite sides of the crystal. This discovery opens the possibility of engineering the efficiencies of macroscopic PECs into low cost, high surface area catalysts.

Left: schematic illustrating reduction and oxidation on opposite faces of a catalyst particle and an SEM image of a $BaTiO_3$ crystal with reduced Ag (light contrast) localized on the ~ 1 μm² (001) face.





Undergraduate Laboratory Makes the Front Page

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• Undergraduate laboratory exercises, reproducing classic experiments in the materials science literature, have been created, implemented, and published on the web: http://neon.materials.cmu.edu/rohrer/defects.lab.html

• Images from a sample produced by CMU sophomore undergraduates during a class in the Fall of 2002 (Brian Close, Justin Samuels, Hilary Stern, and Todd Rogers) won second place in the ceramographic competition at the annual meeting of the American Ceramic Society and one picture was selected for the cover to the June 2003 issue of the society's Journal (see left).